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ABSTRACT

This study involved a series of seminars designed to help preservice students understand and clarify their views about teaching and learning and to create a condition for the development of an understanding of the underlying concepts which affect their teaching and learning. The seminars tested the hypothesis that learning to teach is improved through the application of a questioning and reflective orientation. Fifteen graduate students enrolled in a seminar in early childhood education participated. Self-questioning strategy training was conducted to help students raise specific higher-order questions from assigned reading materials. The reciprocal peer-questioning condition was created to promote social construction of knowledge, providing a context which fostered the emergence and resolution of socio-cognitive conflict. After each seminar session, students recorded their thoughts regarding topics discussed, issues raised, and questions unanswered. Weekly journals were collected by the instructor for analysis. NUD*IST (Non-Numerical Unstructured Data Indexing, Search and Theory Building) software was used for initial theory building and analysis. Students' weekly journal entries indicated the conceptual transformations that they went through. This study illustrated how a seminar structure was useful in helping preservice teachers' evolving constructions of knowledge, in promoting reflection, and in enhancing conceptual change. (Contains 15 references.) (Author/SM)

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Running head : CONCEPTUAL CHANGE

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The Road to Pre-service Teachers' Conceptual Change

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Abstract

This study involved a series of seminars designed to help students understand and clarify their views about teaching and learning and to create a condition for the development of sharing understanding of the underlying concepts which affect their learning and teaching. The seminars tested the hypothesis that learning to teach is improved through the application of a questioning and reflective orientation. Fifteen graduate students enrolled in a seminar in early childhood education participated in the study. Self-questioning strategy training was conducted to help students raise specific higher-order questions from the assigned reading materials. The reciprocal peer-questioning condition was created to promote the social construction of knowledge because it provided a context which fostered the emergence and resolution of socio-cognitive conflict (King, 1990). After each seminar session, students recorded their thoughts regarding topics discussed, issues raised, and questions unanswered. Weekly journals were collected by the instructor for analysis. NUD*IST (Non-Numerical Unstructured Data Indexing, Search and Theory Building) software was used for initial theory building and analysis. Students' weekly journal entries indicated the conceptual transformations that these students went through. This study illustrated how a seminar structure was useful in helping pre-service teachers' evolving constructions of knowledge, in promoting reflection, and in enhancing conceptual change.

The Road to Pre-service Teachers' Conceptual Change

A constructivist orientation to learning is becoming main stream practice in early childhood education. Several teacher preparation programs have been designed to help pre-service teachers shift toward a more constructivist approach to teaching by creating opportunities for them to reflect upon their initial beliefs and practices about teaching and learning. Prawart (1990) advocates a constructivist approach to teacher education that looks for changes in the pre-service teachers' views about teaching and learning which influenced their teaching practice.

Su (1992) claims that teacher education students have the potential for changing their views regarding reasons for schooling from basic skills education to broader perspectives about learning. Since pre-service teachers have potentials for change, it may be possible to facilitate their learning to teach by examining preconceptions, allowing them to explore new awareness, and challenging their ideas through cognitive conflict (Feiman-Nemser, McDiarmid, Melnick & Parker, 1989).

When an external event challenges pre-service teachers' ideals about teaching and learning, efforts to resolve the conflict lead to professional growth. Some researchers have demonstrated that pre-service teachers' beliefs can be changed by uncovering and incontrovertibly confronting students' misconceptions before proceeding with instruction (e.g., Bennett, 1997; Posner, Strike, Hewson & Gertzog, 1982). Other researchers suggest that questioning, reflecting, and problem solving can be applied to achieve the goal of " concept change" (Clark, 1988; Crow, 1987; Feiman-Nemser, McDiarmid, Melnick & Parker, 1989; Gunstone & Northfield, 1992; Posner, Strike, Hewson, & Gertzog, 1982). Under such circumstances, pre-service teachers can

construct their own learning through an interaction among their beliefs, their prior knowledge and their experiences. This interactive process is required to assimilate the new information and to accommodate old schemata in order to change prior beliefs about teaching and learning.

To enable pre-service teachers to see the connections between their beliefs about how children learning and their own teaching, and their own study in teacher education, their assumptions, knowledge, and beliefs would be challenged through their learning experiences. This study was conducted in an effort to document the impact of the seminar course structure which may lead to better understanding of knowledge construction which evolved in teacher education and the ways which challenge and shape their beliefs.

Methodology

Participants.

The sample consisted of fifteen female graduate students who enrolled in a graduate seminar in early childhood education during the Summer 1999 semester. Eleven out of fifteen were school teachers. This three-credit course is described in the University catalog as follows: "The course provides an atmosphere whereby the student is expected to synthesize content, principles and skills garnered from prerequisite courses into a comprehensive view of the products and processes in early childhood education." This is an elective course for early childhood education which they are expected to take toward the ending level of the masters degree. All participants were volunteers and agreed to participate after signing an informed consent form.

Procedures.

Course description. Self-questioning strategy training was conducted to help students raise specific higher-order questions from the assigned reading materials. The reciprocal peer-

questioning condition was created to promote the social construction of knowledge because it provides a context which fosters the emergence and resolution of socio-cognitive conflict (King, 1990). Students were required to write an autobiographical report which served as a means to know the students' personal background, school experiences, existing beliefs teaching and learning, and conceptions of knowledge in the early childhood education. Using the students' initial response, the instructor probed for details and clarification of the students' prior knowledge and background in this class discussion.

The instructor presented several research studies (e.g., the coordination of perspectives; the concept of age; the development and use of ability to classify; number concepts at age 0-5; layout of a model village; the drawing of geometric figures) which got the students to think about how children learn. Students were expected to raise their own questions and try to answer these questions by trying experiments with children at the ages of 3 to 11. Students were required to complete a report based on their experiments with children. Their report included the following: how they defined the questions, relevant information for the questions and the method of answering the questions, techniques for answering the questions, their solution to answer the questions including why this solution is adequate, and the evaluation of what needs to be done next. These reports were graded based on the quality of students' questions and their ability to use effectively the resources available to them in attempting to answer the questions.

Students were also expected to summarize the assigned articles before attending the classroom discussion, briefly report their summary to the class, and raise questions for class discussion. The instructor evaluated students' oral reports based on their familiarity with the materials and their stimulation of the thinking of class members. After each class session,

students had to record their thoughts regarding topics discussed, issues raised, questions unanswered, and reflections on their experiences of these topics, and then develop implications for their own classroom teaching. They were encouraged to use journals during class discussions. A journal was designed for applying self-questioning procedures which helps students process information following oral presentations and discussion made in this class. The journal was collected weekly throughout the semester.

In addition to completing the journal, the students were provided with a one-on-one conference with the instructor to talk about their journals. At the conclusion of the semester, students were asked to answer a course evaluation which was designed to help the instructor gain a better understanding of how to assist learning and how the instructor's actions as a teacher were being perceived. Confidentiality was assured to the students.

Analysis

Weekly journals that were created by 15 graduate students served as data for analysis. They included summary of the assigned articles, questions having been raised, identification of the areas of the written assignment which the student found particularly helpful, their thoughts regarding topics discussed, issues raised, and questions unanswered, reflection of the students' own experiences on these topics, implications for students own classroom teaching, reflective comments and /or suggestions for the next seminar session.

The analysis was conducted by the instructor, one of the participants and a professor who was not involved this course. NUD*IST (Non-Numerical Unstructured Data Indexing, Search and Theory Building) software was used for initial theory building and analysis. The researcher uploaded the journals, then chose paragraphs as text units to be used in the analysis. The

researcher created codes and categories in which a copy of each text unit was stored through a code- and retrieve system. Once the codes had been created, the data had been identified, and saved to a particular category, reports were printed and reviewed by a professor from outside of this course and one of participants. The issues of confirmability had been addressed through inspecting and commenting from different perspectives. One of the participants coded the text segments on codes that indicate the degree to which she thought the codes were indicative of the researcher's initial code. After the secondary coding was completed, the researcher examined those codes that were either coded well or coded poorly. The confirmability reports were generated for the further analysis. Emerging patterns in the data were justified and are reported in this paper.

Results and Discussion

One purpose of this study is to gain an understanding of knowledge construction which evolved in a graduate course in teacher education. We have learned this process of construction by examining changes and consistency in the content of their weekly journal. The themes which emerged from the weekly journal center around students' views regarding thought-provoking issues such as using observation and interview techniques to understand children's thinking, understanding children's inability to copy shape and constructing part and whole relationships. These thought-provoking issues indicated the necessity for understanding how children learn. For example, one student commented, "I never knew that someone could learn so much from children by just watching them play." Another student concluded, "A child may understand what half is; he or she still may not understand the concept. I didn't realize this could happen."

A third student stated that her misconception was clarified through reading about the drawing of

geometric figures by Faye B. Clark. She commented that she thought that a child's inability to copy or draw a shape was based solely on their motor development. Through reading this article, she realized that it depended more on the child's mental development. She started to become aware of the fact that children in certain periods think very differently from adults. Another student also stated, "I was particularly fascinated about Piaget's findings about children's inability to copy shapes. I always assumed it was because of undeveloped motor ability. My experiences "teaching " handwriting to first graders was based on developing fine motor skills, purely behavioral in nature I now assume."

Many students in this class were surprised to learn that it is more difficult for a child to learn to separate a part from a whole than it is to separate a whole from a part. One example of this concept was in the problem a. 8+2=____, b. 8+___=10. In order to come out the answer for question a, the child has to be able to put two parts into a whole. In order to answer question b, the child has to do opposite mental actions at the same time- - put two parts into a whole and cut the whole into two parts. From their conceptions, those two mathematical operations are the same because they involved the same numbers. They had not realized the greater cognitive complexity of the second problem.

In another vein, students' weekly journal entries indicated the conceptual transformations that these students went through. The inter-individual differences in weekly journals were far more striking than the similarities. Thus, we identified the conceptual differences that distinguished one type of teachers' views from another within the domain of instructional practice. Based upon their writings, we categorized three distinct types of teachers.

Type I: Behaviorist images of teaching and learning. Most students' commented on

instructional practice through using telling and demonstrating what children need to know with reinforcement and learning through manipulating and practicing. Their comments regarding telling and demonstrating include:

> I think children will understand "measurement" better, because I have made references to it before during class. Meaning pointing out differences in sizes, comparing height and lengths.

According to these teachers, children are taught directly how to use the ruler and the concept of numbers. The following examples from 3 students' journals reveal the behaviorist practices they advocate.

- Giving children opportunities to explore and experiment with using the ruler, demonstrate using a ruler to children.
- Present the information to the child ...
- Help children learn through visualization.

In these examples, we see that students were translating theories of child development into theories of early childhood teaching practice. From one of the participants, we can see the impact of child development theory on her. She described her practice in the following way:

> I will help students visualize the understanding a concept through reasoning, not just relying on their senses . . . to help visualize the shapes of the objets when trying to seriate or classify. . . . children can perform better when they are able to visualize the task . . .

One of participants stated that she would "encourage children to make their decisions, tell the rules of what is right and wrong, teach morals and values."

This kind of "teaching" which has ready-made values taught violates the ideas of what a teacher

would do on the basis of constructivism which we were discussing in class. Constructivists believe that knowledge is built by an active child from within rather than being transmitted from outside the child.

Further students comments regarding manipulating and practicing include:

> Provided concrete objects familiar to them in order to enhance their abilities to build relationships to other manipulative.
>
> Provide many experiences, activities and games that allow children to practice and become comfortable with the more advanced tendencies that are emerging in their thought.
>
> Giving students the opportunity to learn through their senses by having them experiment on the sense of touch by allowing them to physically manipulate different types of mediums.

Those examples indicate that most students in seminar class held empiricist views about teaching which assumed children learn through their senses.

Type II: Transitional from behaviorist to constructivist images of teaching and learning.

Type II teachers involve children in planning and rule-making. While they emphasize children's learning of specific skills, which may not necessarily lead to children's understanding, they do not mention facilitating children's thinking process which is the major constructivist pedagogical thinking. Thus, they appear to assume an underlying behaviorist view of learning but take the step toward greater student involvement in creating the rules and making decision about the classroom community. Their comments include sharing the decision making process with children, and creating learning community. One student wrote,

> In my classroom, I feel that, in a sense, I am preparing my students to live in a democratic

> society because I allow my students to exhibit those rights that we say that they have. They have been instrumental in a lot of the decision making practices in our classroom. At the beginning of school, I had a sign on the door that stated, "Welcome to Mrs. Robinson's class" with that sign on the door, I thought about how my students probably felt when they entered the door. I thought about the fact that perhaps they didn't feel that the classroom was theirs, but instead mine. As a result of my thinking, I decided to remove that sign and I replaced it with one that stated, "Welcome to Our class". With this new sign in place, the children felt that this was indeed their classroom and not mine alone. In addition to the sign, I allowed students to help in the making of the rules for the class, as well as, the consequences for violating those rules. I allowed students to somewhat lead class discussion based on subjects that were first initiated by me, and I also allowed my students to select their own seats because children tend to do better where they are most comfortable.

While some students commented on using play as a tool of understanding children's thought process, another student described her role of the teacher as going beyond classroom responsibilities to include roles such as advocating the importance of play in the learning process of a child.

In general, Type II teachers comment on getting parents involved and educating parents. They were aware of importance of parent involvement and individual differences in children. They have greater capacity to understand critically the concepts which were proposed in this course, to make relationships, to test their own hypotheses and to integrate new knowledge with their prior experience and understanding by situating themselves within their own teaching. In this way,

individual participation in class discussion leads to them toward better understanding and these issues are been reconstructed when teachers reflect on their own experiences.

Type III: Constructivist orientation toward teaching and learning. The teachers' role and learners' development are highly differentiated by constructivist teachers. These teachers are aware of the aspects of development that are specific to each concept (e.g., concept of age, space) and the process of construction which leads to their ideas of an integrated application in the classroom teaching. The Type III teachers' approach to instruction is based on the development of children's understandings in different conceptual areas and a constructivist way of evaluating children's thinking in each concept and across each concept. Type III teachers can construct a pedagogy and analyze strategies to determined the extent to which they promote constructivist learning.

To illustrate Type III teachers, we chose a particular student in this class who models active learning in her education and constricitvist practices in her teaching. Through the continuing discussion and journal writing about how children learn, she demonstrated her capacity to test her own hypotheses and to integrate new knowledge with her prior experience and understanding. Her comments regarding helping children's thinking processes include the following:

- Provide for opportunities for the child to make constructions.
- Engaging children in problem solving which allows for constructive thinking.
- Help children trust their own judgment and thinking this year by using effective questioning strategies and any opportunity to develop conflict resolution strategies.

Throughout this class, the researchers examined their own conceptual understanding of the process of development through which students' beliefs evolve as well as the barriers of changing students' views. From further examination of these three types of teachers, we reached several important learnings. The first learning involves identified barriers of their learning which had emerged from Type I teachers' weekly journals. The first identified barrier of their learning was that the teachers' initial beliefs and practices about teaching make it difficult for them to understand some ideas which are greatly different from their own. A second barrier was that some of the students' weekly journals reflected their struggles to understand the course concepts, particularly one of the students who had just begin the masters program. It was hard for her to comprehend the reading assignments. She addressed the class discussion as helpful for her understanding.

The third barrier was misinterpretation and misunderstanding. The general problem of students' misinterpretation and misunderstanding arose when discussing children's concept about number. For example, in Kamii's article (1997), Number Concepts at Age 0-5, the author has tried to clarify some tasks such as counting, exercises in making one-to-one correspondences, sorting, and reciting numbers, which are not required number concepts. The student didn't grasp the concept that counting is social knowledge which doesn't require number concepts. She had proposed the right answer with wrong reasons and followed up with the traditional practice of teaching which is in opposition to what the article was trying to convey. Kamii (1997) was saying, "If children think about making a one-to-one correspondence, this idea is significant because it comes out of children's logic. In contrast, if the idea comes from someone else, the one-to-one correspondence is only a perceptual, motoric, and behavioral exercise in obedience."

After class discussion about how to provoke children to come out of their own ideas for counting, not teaching them to count using a one-to-one correspondence, the student came up with the idea of using objects to sort by color by placing all red objects in a red cup, blue objects in blue cup etc. This violated the key issue we had just talked about. If sorting activities carry out the teacher's request, there is a little room for children to construct their own reasoning.

Some teaching strategies the students suggested deprive children of process of deciding what criteria they would like to sort by, which is valuable part of the children's development of hierarchical inclusion and part-whole relationships. Another example concerns a student who didn't grasp the concept of learning; "If we have children who are thinking, then we must first have a teacher who is thinking also. Children can start fractions at the age 6, but if they happen to give the wrong answer, don't correct them. We really have to work hard on fractions, but it's done even if children can visual see and touch the materials."

Some students are behaviorist in the area of "instructional practice and decision-making role," regardless of their beliefs about the other aspects of their teaching. They were not aware of the contradiction among their views. In this sense, making every student aware of the contradiction among their views may be the first crucial step in an instructional strategy for facilitating accommodation.

A second learning from this study relates to our understanding of the development of the belief systems of in-service teachers versus pre-service teachers. In this study, 4 out 15 participants had no prior teaching experience whatsoever. In reviewing the weekly journals, we saw that those graduate students appear to be relatively undifferentiated in their conceptions when compared to those students who are teaching. It is much easier for teachers to relate to

their experience of working with children to the concepts in this class. The students' thought-provoking issues, which indicated the necessity for understanding how children learn and what children think, reveal that teaching experiences provide an important base for their interpretation and understanding about how children learn. In the words of one teacher.

> I have noticed that children cannot draw what they see, but can draw what they think they see. For example, one day I had my students to draw a self-portrait and in those portraits I noticed that some children had used a variety of colors to try to make their pictures appear to be as real to me as possible. I noticed that a lot of children whose hair was blonde tended to use the color yellow to represent that color as well as, children who were of the African American descent, used either the color brown or black to represent their skin color. I thought that was very interesting, however I never thought about the fact that those students were drawing according to what they thought about the fact that those students were drawing according to what they thought that they had seen and not what they had seen. Thanks to these articles, I now understand that my little red head students didn't actually think that their heads were the color red, but they used the color red to represent what they thought that they had seen.

Last, we learned from this study that the learner's effort to understand is the drive for concept change. Students reveal this drive through their efforts to relate to their observation of the children, to relate to their experiments with children, and to examine their own philosophies as teachers. In the words of one Type III teacher,

> The following question was put to the class for discussion and position, ""How as teachers can we promote children's construction of hierarchical inclusion and order out of the

relationships they make?" This has been perhaps the hardest question for me as a teacher to answer because it required me to think through my own philosophy as a teacher. It made me stop and think about all that I know about children. If we know how children think and we know that children must have opportunities to think in order to construct mental relationships; then we can pose problems in a way that children will be able to use what they know and experiment with what they don't know to construct knowledge. . . . Teachers should not be fooled into thinking that the reason for presenting a variety of strategies for problem solving is to help foster children's thinking and is thus constructivism. It is not. I feel it is merely ""paying lip service" to the theorists. Children are still not inventing and reinventing their own ways, they are still not considering another classmates solution, rather an adult's solution. They are not becoming more efficient; rather they are becoming more deficient because of the confusion. . . . Teachers must also be aware of situations in which children might negotiate, debate, and defend their thinking. If children do their own thinking rather than being told, then the children will be able to think logically about other issues that are social/moral. Conflict situations that arise and questioning strategies that we use will help children develop a confidence and autonomy to defend their ideas in public and later to defend the moral choices they make. When children are encouraged to continue to solve a difficult problem, when children are asked to think really hard about an issue that matters to them, they have to use all their constructed knowledge (reversibility of thought, perspectives, whole/part relationships, etc.) and their intuition to either defend their position or modify their thinking. All this being said, how do I as a teacher prepare myself to pose questions and plan situations in

the classroom that will promote the construction of number concepts and the development of hierarchical inclusion and order?

Conclusion

In this paper we have described the process we used for designing this graduate class through self-questioning strategy training, autobiographical report, summarizing research articles, classroom discussion, weekly journal, and experiment with children. This study illustrates how a seminar structure can be useful in helping pre-service teachers' evolving constructions of knowledge, in promoting reflection, and in enhancing conceptual change. By implementing this course design, the instructor had committed herself to an endeavor that will enable students to construct their understandings of relationships between theory and practice.

A critical issue addressed by several participants in this study is the idea of "demanding class participation" which removed the pleasure and satisfaction of sharing with other students, although many of participants had cited benefits. Students did not all master the same content at the same pace. They should not be tested on their knowledge acquisition, nor did they necessarily construct the same meanings from this learning experience. The students should have opportunities to share their emerging understanding the content in small and large groups. So the timid students can listen to the others' views without feeling pressure to participate. In small group discussion, the students have opportunity to ask questions related to their particular situations or gain the satisfaction of sharing with other students.

The weekly journals serve as one way of knowing our students, as well as a tool for their professional growth. In their own voices, the students in this seminar class illustrated their evolving constructions of understanding and the relationship of their experiences in this structure

of class learning. This study suggests that teacher education course design requires learning opportunities that encourage in-depth examination of educational theories which investigate how children learn. Then they can determine what conceptions of teaching are most appropriate for young children. While many teachers in this class had intuitively sensed certain principles of teaching, they could not explain their practice on the basis of a theory of learning. Early childhood teachers must acquire a range of knowledge, skills, and attitudes to succeed in teaching (Saracho, 1984). In teacher education, we need to provoke their ability to go beyond this level of explanation to achieve the goal of developing a thinking teacher. While requiring prospective teachers to think, it might be useful to change early childhood teacher education programs to reflect the way what they expect to teach, what they do, and why they do.

The instructor in this class was experimenting with her teaching strategies informed by concstructivist learning theories (Fosnot, 1996, 1989; Richardson, 1997) by encouraging students to exam their beliefs about teaching (Fosnot, 1989). We believe that students learn how to teach when taught the way they are expected to teach and expected to make decisions reflecting theories and research on teaching and learning. We considered this course design as a starting point to continue to evolve our thinking about the ways for helping early childhood teachers make explicit the ground upon which they interpret and connect their experience of teaching and of teacher education. The structural research design provided valuable insight for refining the instructor's own teaching practice and understandings of what it means to develop as teacher.

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